Ministry of Agriculture, Food and Rural Affairs

Soils 101 and Soil Health

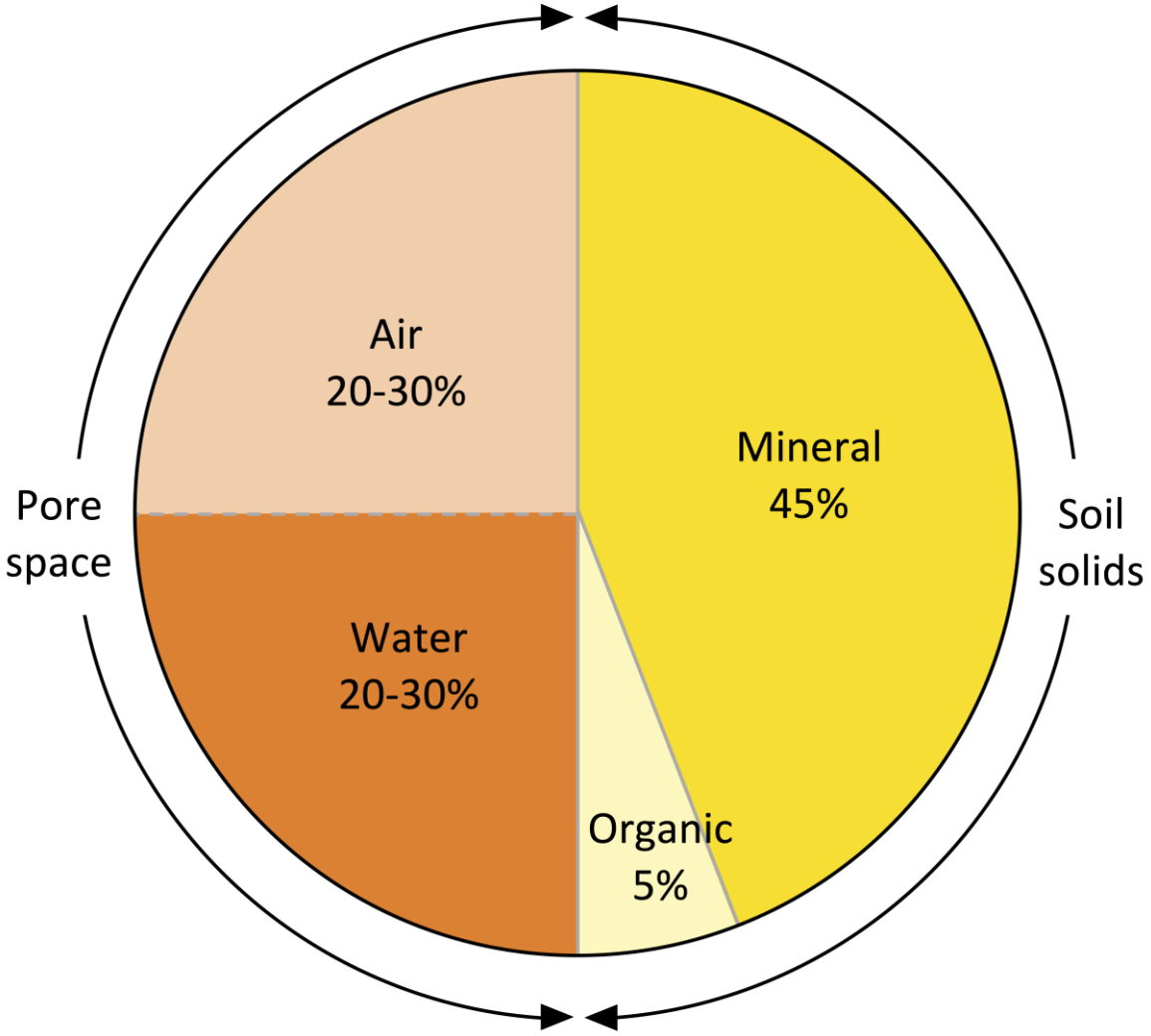
Steph Vickers

Sustainability Specialist (Horticulture Crops)

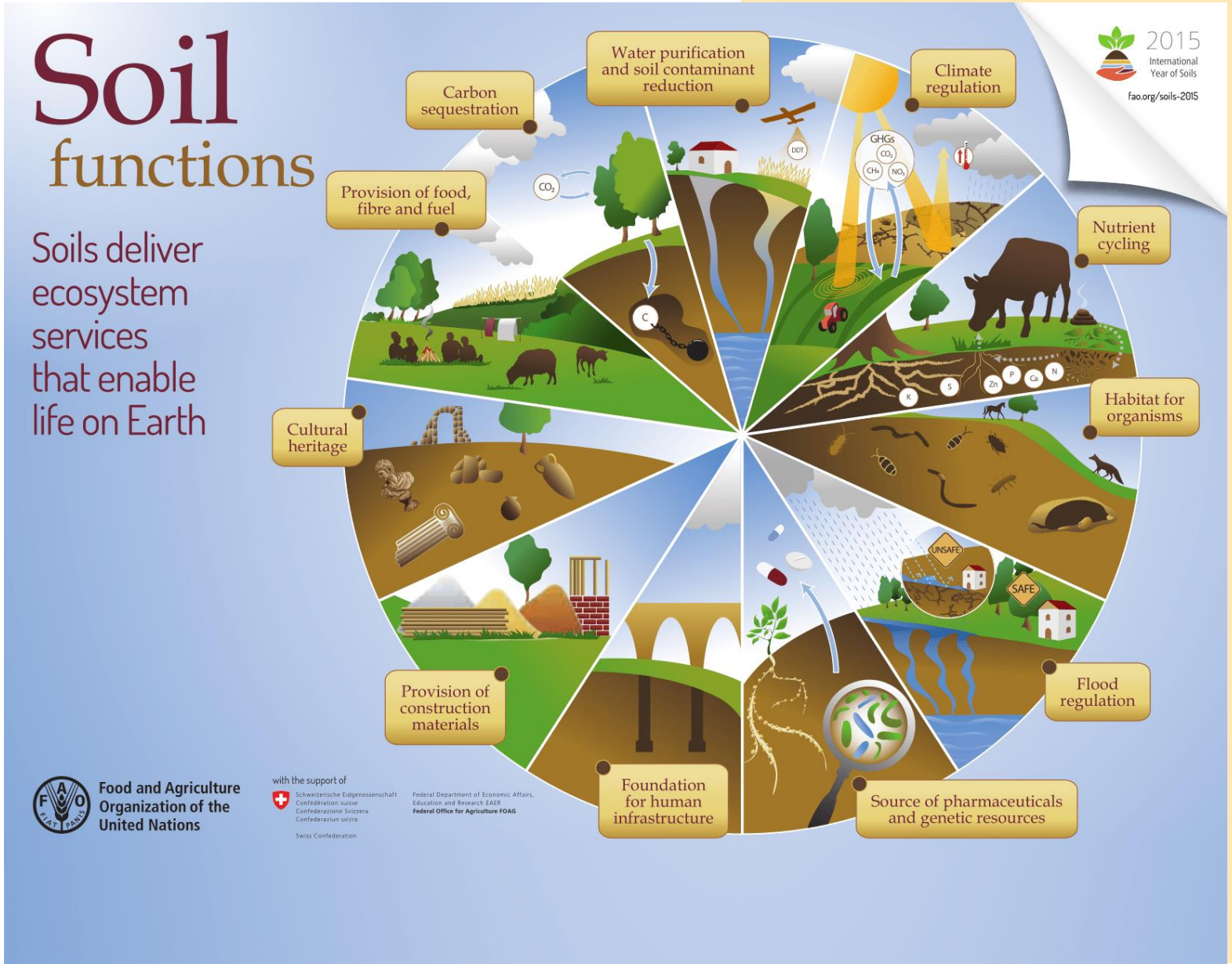
September 23, 2023

Ontario

What is soil?


Air
20-30%
Mineral
45%
Pore
space
Soil
solids
Water
20-30%
Organic
5%

Why do we care?



How did our soils form?

CL O R P T

CLIMATE

Temperature speeds up or slows down chemical reactions that break down, or weather, rocks and minerals. In areas of high rainfall, more water drains downward, leaching minerals through soil layers.

ORGANISMS

Burrowing animals, growing plant roots, and enzyme-secreting bacteria and fungi chemically alter and physically mix soils.

RELIEF

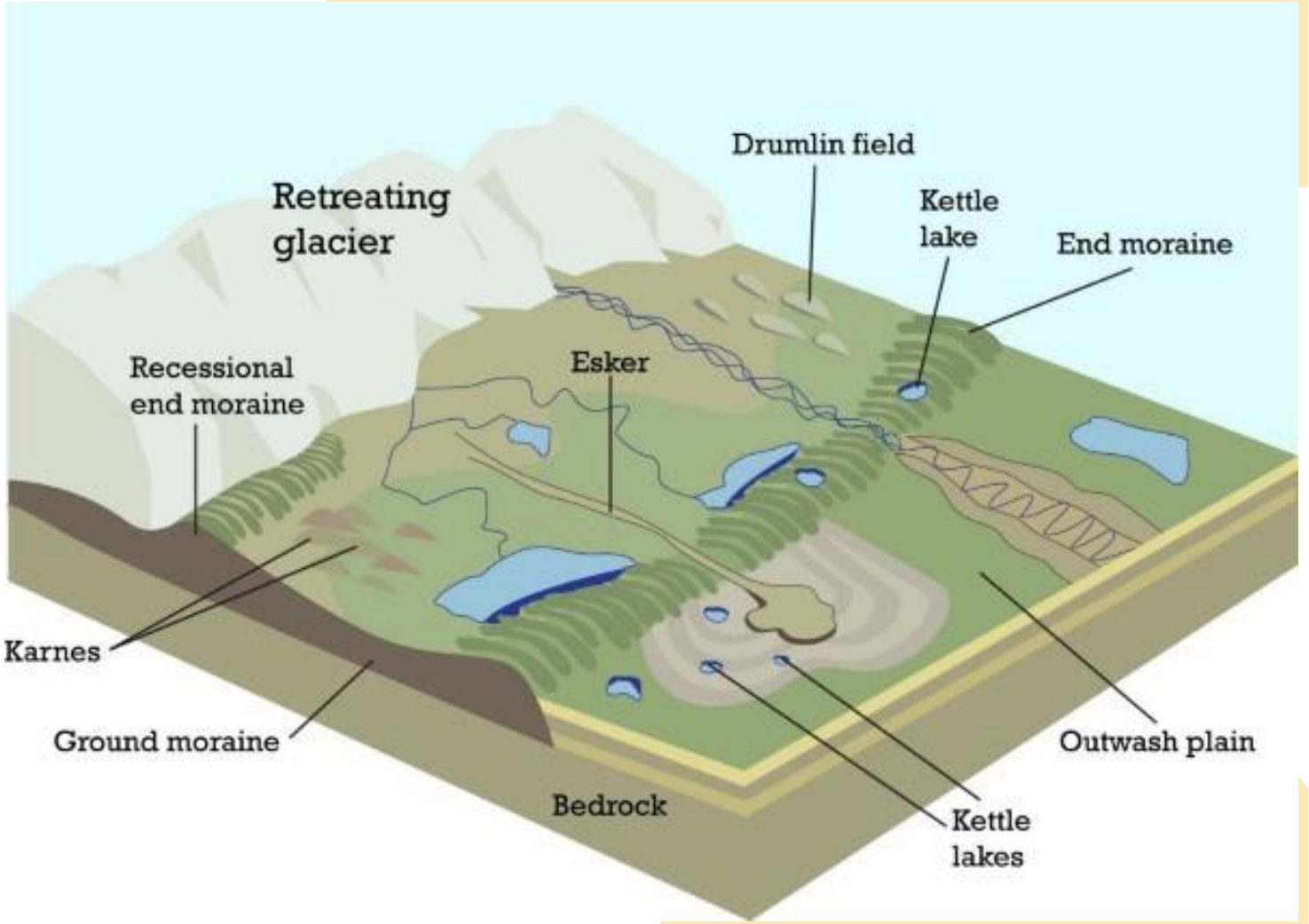
Topography—the slope and the direction a landscape faces—influences sunlight hours, temperature, water runoff, erosion, and organic matter build-up.

PARENT MATERIAL

The chemical composition of original unweathered rock influences the mineral content of soil. Parent materials can be the underlying bedrock, but most are sediments-sand, silt, or clay carried in from elsewhere by wind or water.

TIME

Weathering partly depends on age: older soils are more weathered than younger ones. Soils in the tropics tend to be old because they have not been affected by the remixing effects of glaciation.



Get to know your soil profile

Can use:

- Soil probe
- Shovel
- Auger
- Backhoe

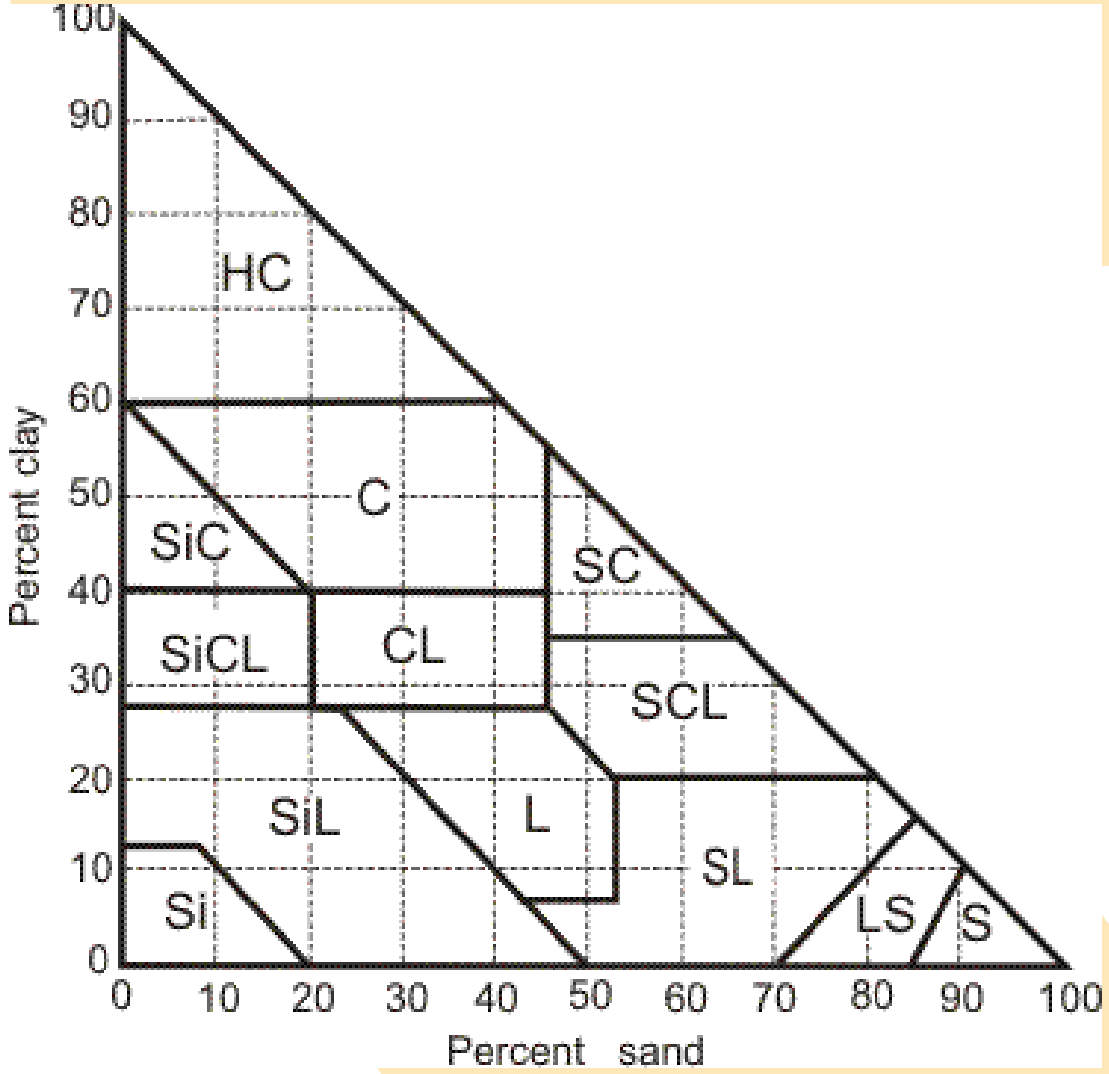
Gives you info about:

- Landscape & position
- Depth of A horizon
- Textural layers

Now moving onto subjects you might actually care about and use in your daily life…

Soil Texture

- % sand, silt, clay
- ***You cannot (and should not try to) change your soil texture***
- How do you determine soil texture?
  - Online/paper maps: AgMaps (gov.on.ca)
  - CanSIS: Soils of Ontario - Agriculture and Agri-Food Canada (AAFC)
  - Hand texturing: texture-by-feel.pdf (usda.gov)
  - Lab analysis ($$$)



Soil Organic Matter

Organic matter = “the living, the dead, and the very dead”

-Vern Grubinger, UVermont

Soil Structure

Management makes soil structure

You CAN change structure!

Structure influences:

- Water infiltration
- Bulk density/aeration
- Rooting
- Erosion

They're all interconnected…

Compaction

Standing water on headlands in a potato field

Restricted roots & platy structure in tomatoes

Flattened root in corn

Tire ruts in wet soil

Caused by:

- Wet/moist soil conditions
- Equipment weight
- Traffic

Results in:

- Dense soil = restricted roots, stunted growth
- Reduced pore space = less available water

Tillage has hidden it – look for patterns…

Symptoms:

- Standing water after rain
- Drought stress in crop
- Restricted root system (flat or lateral roots)
- Dense layers in soil / subsoil
- Nutrient deficiencies

Compaction happens on sandy soils too!

Get to know your soil!

In the Field:

- Soil profile
- Texture
- Structure
- Compaction

In the Lab:

- Fertility
- pH
- EC/salts
- Nematodes or other soil microbiology

In the Lab: Sampling & Lab Analysis

3 types of soil sampling

Soil fertility & pH

- Depth: 6 in. / 15 cm
  - Depth where most plant roots grow and tillage mixes nutrients into soil
- Keep at room temperature

Soil nitrate

- Depth: 12 in. / 30 cm
  - Nitrate moves with water down the soil profile
- Keep cool or freeze
  - To slow microbial activity (produces nitrate) and prevent overestimation

(don't need to know for lavender)

Nematode sampling:

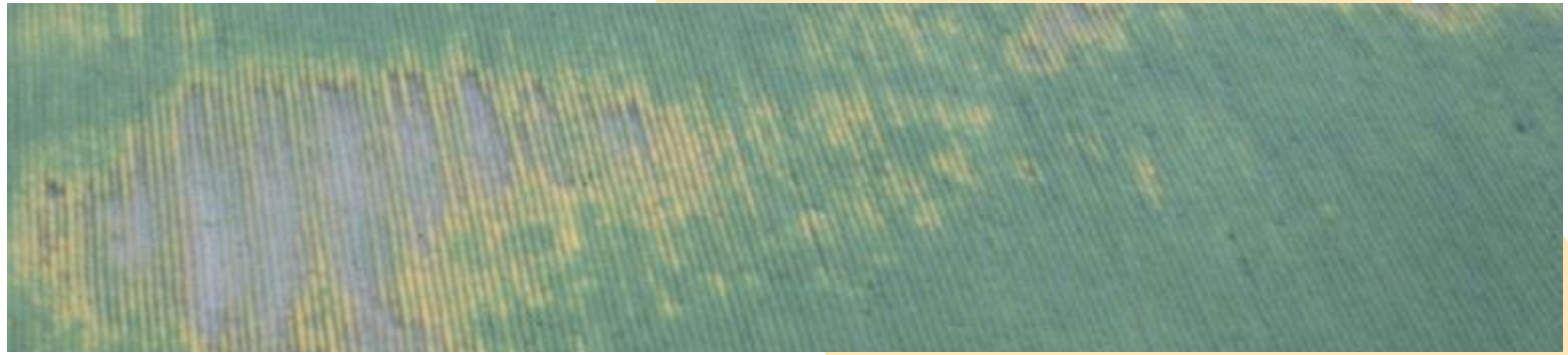
- Depth: ~8 in. / ~20 cm
  - Discard the top 1-2 in. of soil where nematodes would not survive due to extreme env conditions
- Sample cores around root zone of target crop
- Keep cool, DO NOT FREEZE! Get to lab ASAP
- **Nematodes must be alive to be extracted in the lab!**

In the Lab: Sampling & Lab Analysis

Basic soil sampling kit:

- Soil probe
- Bucket
- Bags/boxes & marker
- Cooler & icepacks

Sample from “good” and “problem” areas separately

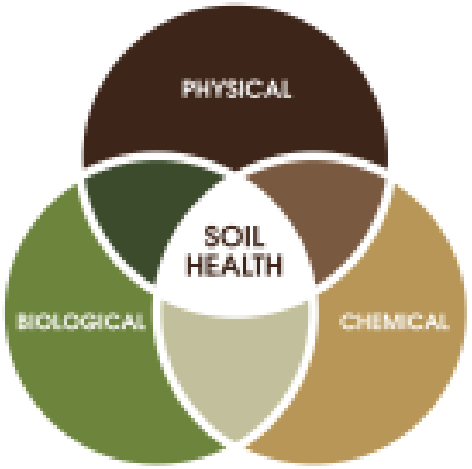


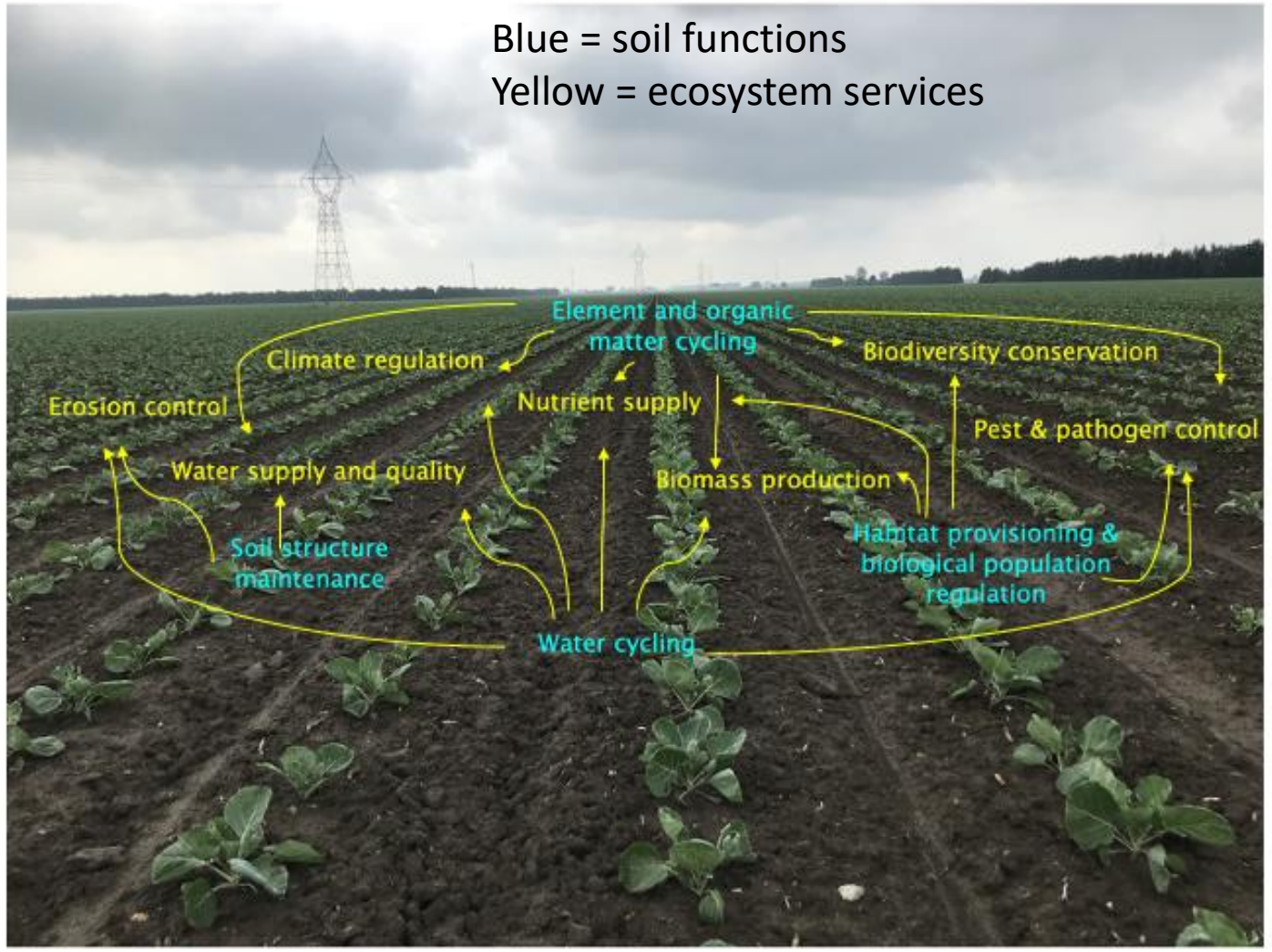
[Soil, leaf and petiole tissue, and forages and feed testing labs | ontario.ca]


Soil health

Soil Health

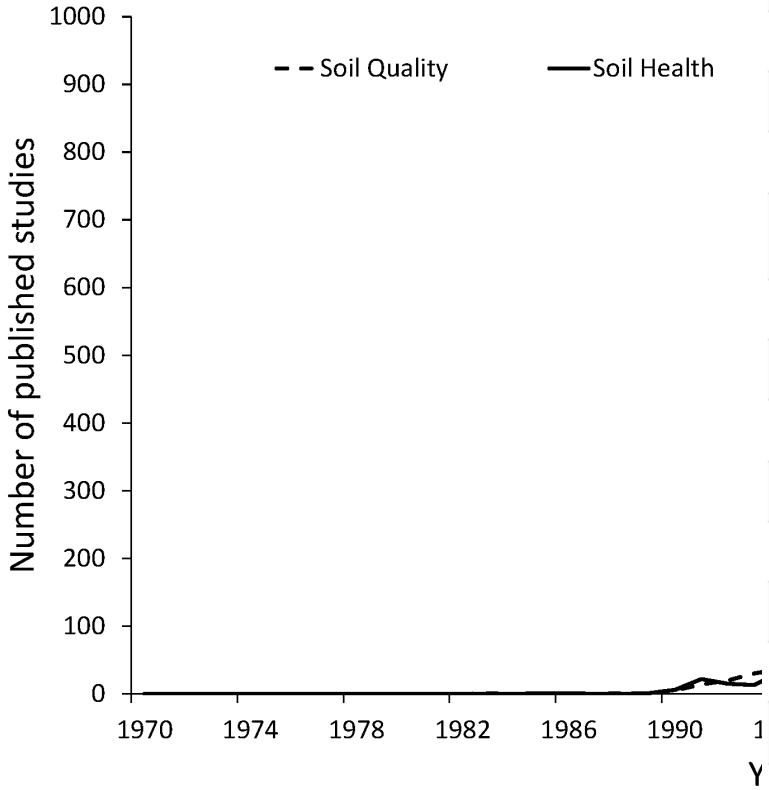
"the capacity of a soil to *function* within ecosystems and land-use boundaries to sustain: biological productivity, environmental quality, and plant and animal health" (Doran et al. 1996)





How do we measure soil health?

For a soil health test to be r
relevant soil function or ec

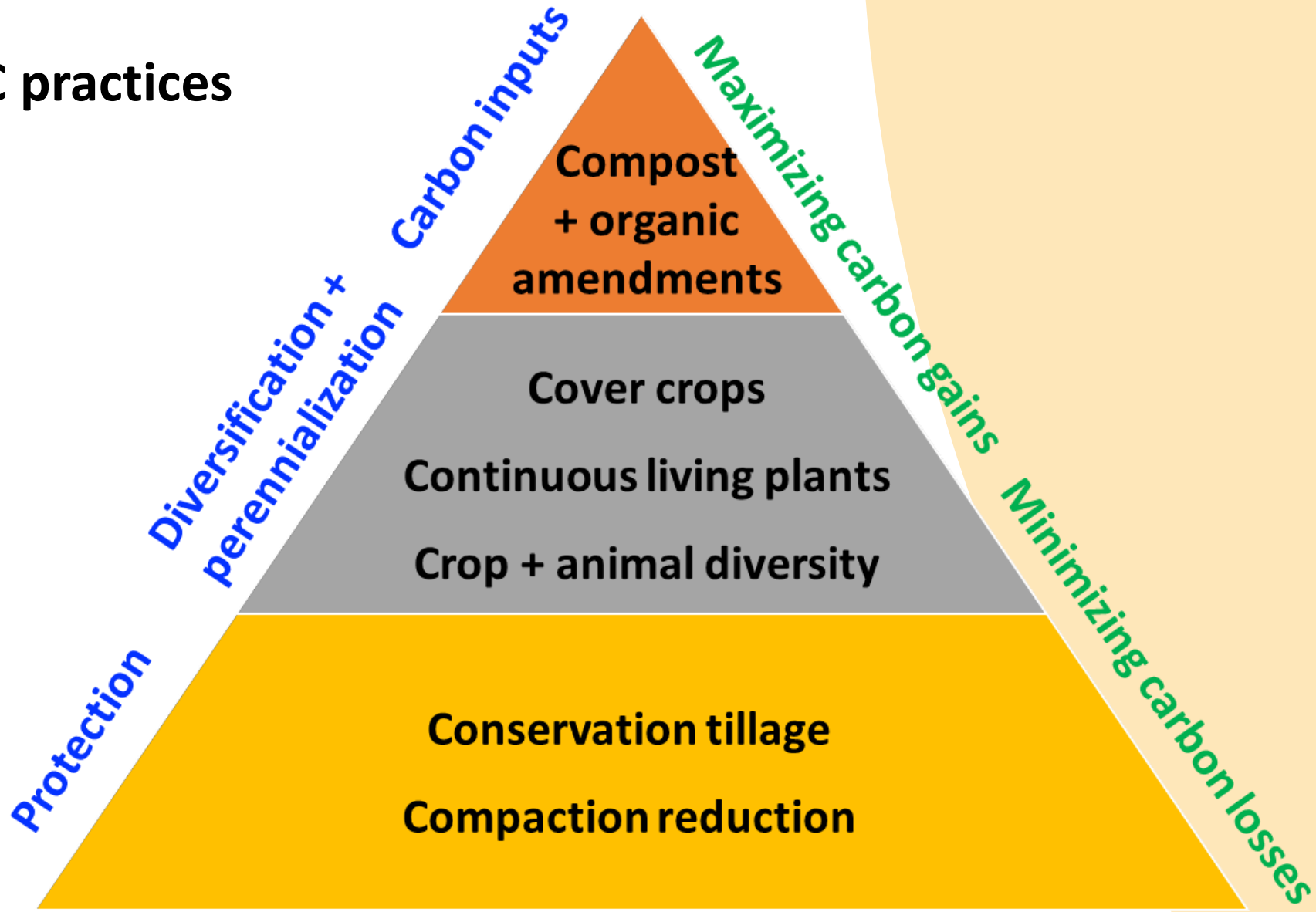


Soil Health Indicator	Comprehensive Assessment of Soil Health (CASH)	Soil Health Management Assessment Framework (SMAF)	NRCS Soil Test Kit (NRCS)	Haney Test (Haney)	Soil Health Institute Evaluation (SHI)	Soil Fingerprint Framework (AAFC)
Physical						
Texture	X	-	X	-	X	X
Aggregate stability	X	X	X	-	X	proposed
Penetration	X	-	X	-	X	-
Available water capacity	X	X	X	-	X	-
Saturated hydraulic conductivity	-	-	-	-	X	proposed
Bulk density	-	X	X	-	X	X
Infiltration	-	X	X	-	-	-
Erosion rating (RUSLE)	-	-	X	-	X	-
Slaking	-	X	X	-	-	-
Crustings	-	X	X	-	-	X
Structure + macropores	-	X	X	-	-	X
A horizon depth	-	-	X	-	-	X
Biological						
Plant growth/yield	-	-	X	-	X	proposed

[Soil Health Assessment and Plan Guidebook – Field Crop News]

How do we improve soil health?

The 6C practices



How do we improve soil health?

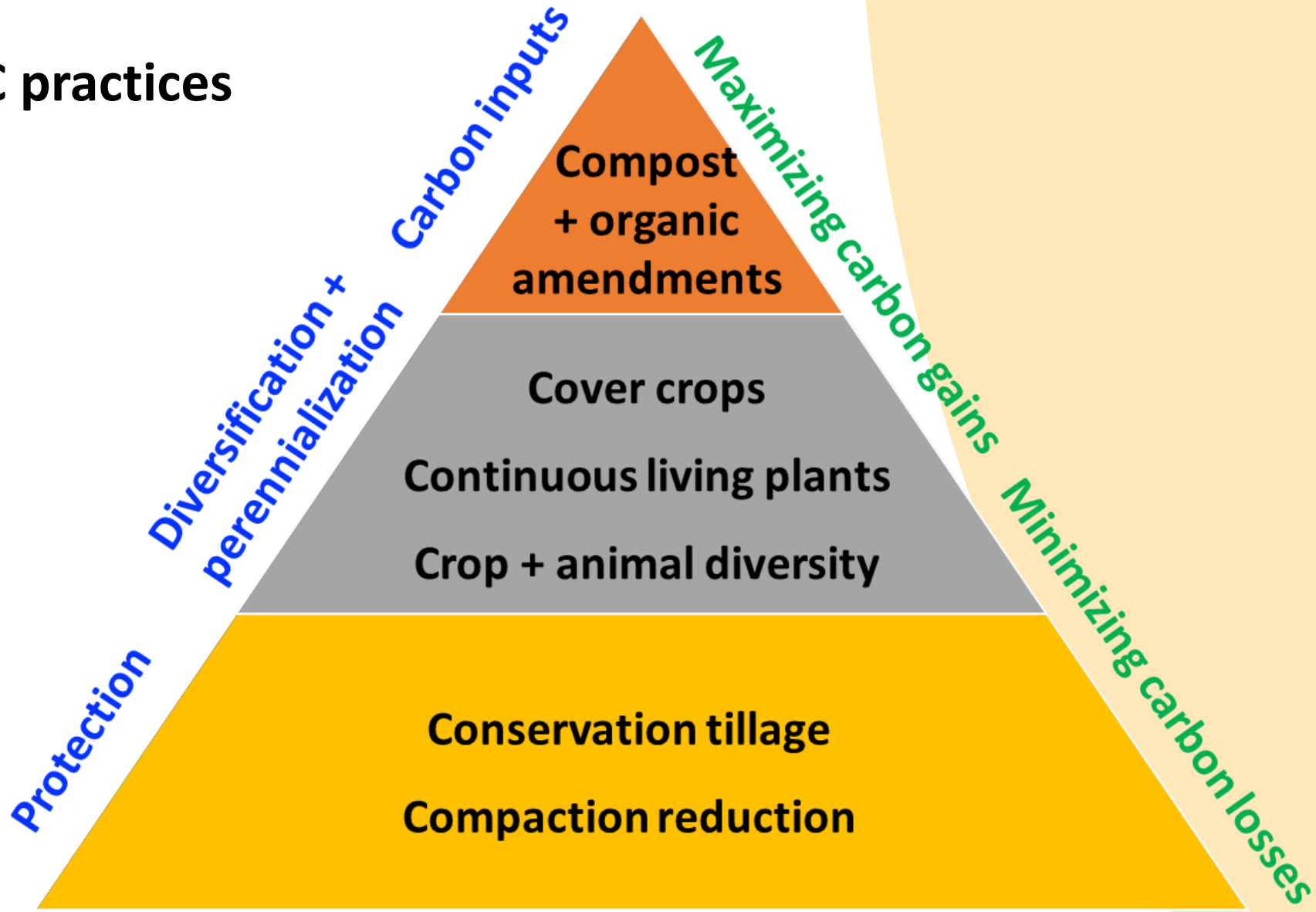
- Composts and organic amendments – applying compost/manure/NASM
- Cover crops – planting cover crops between rows, diversification of crops
- Continuous living roots/plants – growing perennial plants

How do we improve soil health?

- Crops and animal diversity – crop rotation, integrating animals with crops
- Conservation tillage – reduced # passes and tillage depth
- Compaction reduction – avoiding it in the first place, deep tillage (deep ripper, subsoiler), biological tillage, controlled traffic

How do we improve soil health?

The 6C practices



Questions?

Steph Vickers

stephanie.vickers@ontario.ca

519-852-5627